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"Structure-Lithologic-Fluid" Metallogenic Coupling of the Wuzhishan Lead-Zinc Deposit in Puding, Guizhou Province

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1 Introduction

The Wuzhishan lead-zinc ore-concentrated area in Puding is located in the east of the Sichuan, Guizhou and Yunnan lead-zinc metallogenic domain, with the Youjiang-Nanpan River metallogenic province to the south. Cambrian, Carboniferous, Permian and Triassic strata outcrop extensively in this area, with scattered distribution of Cretaceous and Sinian strata. The Upper Sinian Dengying Formation and the Lower Cambrian Qingxudong Formation are main ore-bearing strata and altered dolomite is the main host rock. Complex structure of this area mainly consists of NW-trending Ziyun-Yadou faults, NW-trending Dayuan and Wuzhishan anticline, EW-trending Nayong-Kaiyang faults, and NE-trending Anshun-Pingba faults, etc.

In recent 5 years, the first large Pb-Zn deposit(Pb-Zn reserves ≥ 1.35 Mt) has been explored in the Wuzhishan ore concentrated area, achieving geological prospecting breakthrough. Many scholars carried out research on ore-forming material source, ore deposit genesis and metallogenic regularity(Chen et al., 2015; Jin et al., 2015; Jin et al., 2016), but the research on metallogenic coupling is limited. In this paper, the "structure-lithologic–fluid" metallogenic coupling was explored on the basis of macroscopic geological investigation, combined with isotope and fluid inclusion research, aiming to deepen and enrich lead-zinc metallogenic theory in this area.

2 Typical ore deposit geological feature description--take Nayongzhi ore deposit as an example

Nayongzhi lead-zinc deposit occurred in the northeastern segment of the Wuzhishan anticline. NE- and NW-trending faults development, NE-trending faults mainly includes F_1, F_2, F_7 and etc. (ore directing and controlling faults), and NW-trending faults are the main secondary fault. Pb-Zn orebody has two types such as stratiform or stratiform-like type and vein type. The former occurs in the Qingxudong Formation dolomite at the F_7 footwall, which can be divided into I, II and III orebodies (Figure 1). The latter, steep veins, occurs in F_7 fault fracture zone. They are the products of the same fluid system in different space(Jin, et al., 2016). Mineral composition is simple, and the metal minerals were mainly sphalerite, galena, and pyrite, and gangue minerals were mainly dolomite and calcite. Ore structure contains massive, disseminated, net-vein, breccia and etc.; Ore texture contains anhedral- euhedral granular texture, fracture texture, residual texture and etc. Dolomitization and silicification are closely related to mineralization.

3 "Structure-lithologic–fluid" metallogenic coupling

3.1 Structure is necessary for lead-zinc mineralization and main ore-controlling factors

The Wuzhishan anticline structure developed. All the lead-zinc ore deposits(or spots) having been found and explored occur within the metallogenic boundary controlled by F_1 and F_2. Ore-directing and ore-controlling faults at or near the axis of the anticline control the occurrence of the main orebody. The mineralization in the F_7 fault fracture zone was strong. The thickness of ore bodies and width of faults have a positive correlation. Stratiform and stratiform-like orebodies controlled by interlayer faults distributed at the footwall

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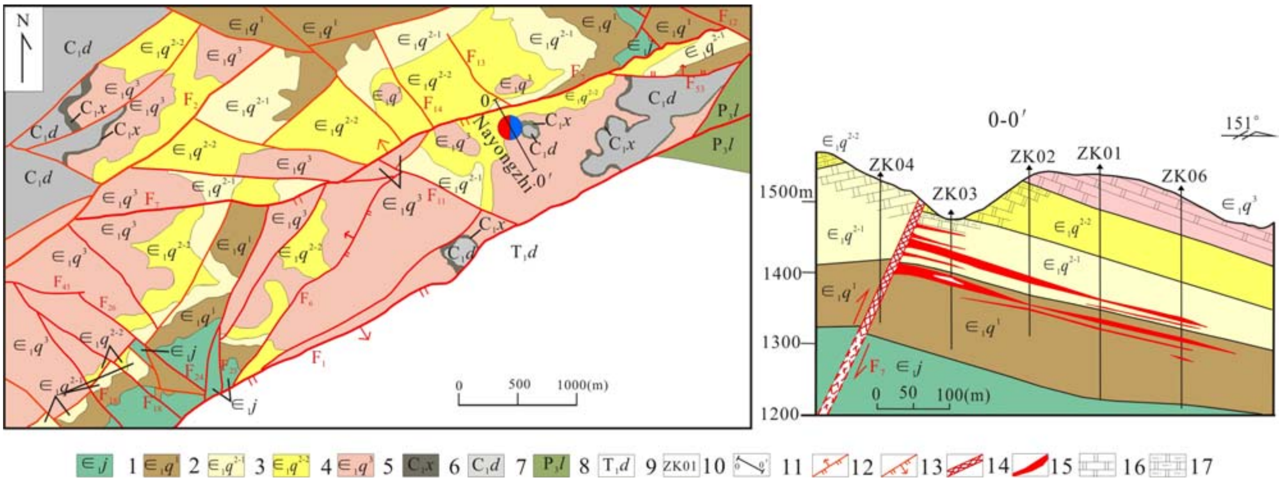

Fig.1 Geological map and No.0 cross section of the Nayongzhi Pb-Zn deposit

1-Lower Cambrian Jindingshan Formation; 2-First section of the Lower Cambrian Qingxudong Formation; 3-First layer of the second section of the lower Cambrian Qingxudong Formation; 4-Second layer of second section of the lower Cambrian Qingxudong Formation; 5-Third section of the lower Cambrian Qingxudong Formation; 6-Lower Carboniferous Xiangbai Formation; 7-Lower Carboniferous Dapu Formation; 8-Upper Permian Longtan Formation; 9-Lower Triassic Daye Formation; 10-Drill and number; 11-Cross section and number; 12-Thrust fault; 13-Nomal fault; 14-Steep veined ore body; 15-Stratiform ore body; 16-Dolomite; 17-Argillaceous dolomite

within the 800m range of the major fault. The closer to the F_7 fault, the higher the ore grade is, whereas lead-zinc mineralization would be diminished or vanished. Characteristics of hydrothermal mineralization and ore-controlling by structure are obvious. In short, the Wuzhishan anticline provides the entrapment structural environment for ore-forming fluid migration and ore deposition and enrichment.

3.2 Dolomite is good ore-containing Lithology

Altered coarse crystalline dolomite in the study area, as the transformation product of regional basin brine activities, is closely related to lead-zinc mineralization. Previous studies show that stronger dolomitization and higher porosity is more likely to lead to the migration of ore-forming fluid during the water-rock interaction and the lead-zinc ore precipitation, enrichment and mineralization (Han, et al., 2012; Zhen et al., 2013). Altered dolomite, spatially and temporally constrained by the metallogenic structure(Han, et al., 2014), is good ore-hosting rock. Lead-zinc mineralization was selective to certain lithology.

3.3 Ore-forming fluid properties and metallogenic dynamics background

Isotope and fluid inclusion investigation(Jin, et al., 2016) show that the ore-forming metals Pb and Zn mainly come from basement rock and ore-hosting rock. Mineralization agent C and S come from marine carbonate rock and evaporate rock at ore-hosting strata respectively. O mainly comes from deep metamorphic water. Ore-forming fluid has the characteristics of multiple source and basin brine with low temperature and low-middle salinity. Metallogenic age in this area ranges from 200 to 230 Ma (Han, et al., 2014). The deposit formed under the geodynamic background of transition from compression to extension.

3.4 "Structure-lithologic–fluid" metallogenic coupling

Water/rock reaction between deep metamorphic water circulation driven by compressional orogeny and strata that the fluid flowed through →the ore-forming fluid formed from leaching and dissolving ore-forming metals and mineralizer migration along the fault→A massive dolomitization and gas-liquid fluid differentiation resulting from vacuum outgassing(leading to rich CO2 fluid escaping into carbonate rocks) (Han, et al., 2014)→ The opening of the structure space leads to the changes of the geochemical environment, resulting in ore-forming fluid differentiation, ore deposition and enrichment. The lead-zinc deposits in this area are the product of "Structure-lithologic–fluid" metallogenic coupling mineralization.

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